THE MINERAL RESOURCES OF THE HUDSON'S BAY TERRITORIES.

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THE regions to which this paper refers include the whole of the Dominion of Canada east of the Rocky Mountains and north of the water-shed of the St. Lawrence. Very little exploration for economic minerals has yet been done in this immense country; but that little has already served to indicate great wealth in some localities. Having been engaged for a number of years in conducting government geological explorations in these vast territories, I shall endeavor to give the members of the Institute an idea of the prospective mineral resources of almost half a continent, as far as they are yet discernible. I purpose confining my observations to the economic minerals, and will not attempt a description of the geology of these territories; but it will be necessary to say a few words about the rocks in order the better to explain the distribution of such minerals.

The Laurentian nucleus of the continent is the principal feature of the geological map of the Dominion. It stretches from Lake Superior to Baffin's Bay, and from Great Bear Lake to the Straits of Belle Isle. Hudson's Bay itself, which is half the size of the Mediterranean Sea of the old world, lies in the center of this area. Its shores are bordered in places with newer rocks. On the west side of James' Bay (its southern prolongation) these extend inland over 200 miles, and consist of fossiliferous Devonian and Silurian strata. On the western and northwestern side of Hudson's Bay proper, altered rocks are met with, some of which resemble the gold-bearing strata of Nova Scotia, some the Huronian of Lake Huron, some the older Huronian, and others the crystalline series of the neighborhood of Sherbrooke in the Province of Quebec.

Along the east coast (called the Eastmain) and among the islands lying off it, there is an interesting set of volcanic and sedimentary rocks which appears to be identical with the Animikie and the Nipigon series of Lake Superior.

The area which I have characterized in a general way as Laurentian, includes tracts and belts, more or less extensive, of the Huronian series. Such areas appear to be most common, and have been best explored, in the country between the Great Lakes and Hudson's Bay.

Most of the islands of the Arctic Sea consist of Silurian strata. On some of the northwestern of them, Carboniferous rocks are supposed to be developed; but possibly, on further examination, these may prove to be Devonian and Cretaceous. Still further north, strata supposed to be of Liassic age have been found.

Between the Laurentian nucleus and the Rocky Mountains, there is a great basin of Silurian, Devonian, Cretaceous, and Tertiary rocks, which, towards the Arctic Ocean, becomes, to a great extent, replaced by non-fossiliferous limestone, probably of Nipigon age. On the shores of the Arctic Ocean, similar limestones, associated with trap, are the prevailing rocks between the Mackenzie and Coppermine rivers. The copper-bearing rocks of the latter river appear to correspond with those of Lake Superior.

In the following brief account of the economic minerals, I shall begin with the metallic ores.

Iron.—A fine variety of magnetite, of which I procured specimens, is said to occur in large quantities near the entrance of Black Bay, on the north side of Athabasca Lake. On Knee Lake, between Lake Winnipeg and Hudson's Bay, I have examined a large deposit of a laminated finely-granular magnetite which, however, Mr. Hoffmann finds to contain only 45.86 per cent. of metallic iron; but it is perfectly free from titanic acid. Magnetic iron-ore is reported to occur on the north side of Hudson's Strait; and small deposits of it are not uncommon among the Huronian bands in various parts of the territory.

Hematite in bands, associated with sandstones, shales, and trap, is found on Long Island, Hudson's Bay; and loose pieces of this ore are often met with on the eastern coast. A promising deposit of hematite has been opened on Big Black Island, in Lake Winnipeg. Two years ago, Captain H. P. Dawson, R.A., sent me a fine specimen of foliated specular iron from a vein on the northern bay of Great Slave Lake.

Clay-ironstone is found on Melville Island, according to Mr. Charles König (in the Supplement to the Appendix of *Captain Parry's Voyage of* 1819–20). Small quantities of it, in the form of nodules and thin layers, occur in many places in the Cretaceous and

Tertiary marls of the northwest territories. In 1875, I discovered a large deposit of this ore, passing into limonite, at the foot of the Grand Rapid of the Mattagami River, a short distance southwest of the head of James' Bay. There are indications of its existence in considerable quantities in various places among the Devonian rocks to the southwest of this bay.

But probably the most extensive deposit of iron-ore in the territories under description is that of manganiferous spathic ironstone on the Nastapoka Islands on the east side of Hudson's Bay, described in my report for 1877. The ore occurs as a thick band, divided into layers of a few inches, overlying the quartzites and shales and running through all the islands of the southernmost ninety miles of this chain. The dip of the strata is low; and the ore, broken up by the frost, forms much of the surface of these islands, there being no timber or soil. Dr. Harrington has analyzed specimens of the ore from different islands and found it to contain on an average about 50 per cent. of carbonate of iron and 25 per cent. of carbonate of manganese. It would therefore be a valuable ore for the manufacture of spiegeleisen.

Copper.—The native copper of the Coppermine River is described as occurring in amygdaloid trap, and, from private accounts which I have heard, it would appear to exist in large quantities. I have found small veins containing copper pyrites on Long Island and one of the Ottawa Islands in the northeastern part of Hudson's Bay. As a set of rocks resembling the copper-bearing series of Lake Superior is largely developed on these islands and the Eastmain coast, copper may be here looked for with a prospect of success. Some of the specimens of granular iron pyrites which I have obtained from the northwest shore of the Bay look as if they contained a small percentage of copper. The quartzites of Marble Island are stained with the green carbonate in some places. Copper pyrites, in small quantities, has been found in the Huronian rocks in various parts of the territories under consideration, and a more promising deposit was described by the late Mr. James Richardson, some miles southwestward of the now celebrated Lake Mistassini. Two quartz veins in Huronian greenstone at the Bruce and Wellington Mines on Lake Huron, yielded sulphuretted copper ores to the value of $3,300,000 between the years 1847 and 1875. Captain Sir John Ross says that he "found copper-ore near Agnew River and Lord Lindsay River," but he does not state what variety of ore it was.

Lead.—Among the rocks of the Manitounuck series on the east

side of Hudson's Bay, a band of drusy bluish-gray dolomite, about twenty-five feet thick, was found on both sides of Little Whale River and at Richmond Gulf. This band contains a good deal of galena in the form of bunches, some of which would weigh about 100 pounds. Galena has been found by Mr. E. B. Borron in veins in Huronian rocks at Lake Mattagami, in the southern part of the basin of Moose River.

Zinc, in the form of blende, is found in small bunches among some of the rocks of the Manitounuck series. Large workable masses of blende occur north of the Battle Islands, Lake Superior, in hornblende schist.

Molybdenum.—A specimen of molybdenite was presented to me at Great Whale River, which was said to have been found in the neighborhood. Specks and scales of this mineral are not uncommon in veins in the Huronian series.

Silver.—The galena of Richmond Gulf was found by Dr. Harrington to contain 12.03 ounces of silver to the ton of 2000 pounds of ore. The same gentleman found silver in small quantities in iron pyrites from a vein in gneiss near the mouth of Great Whale River, and in the same mineral from another vein cutting dolomite, near Cape Jones. As the rocks of the Manitounuck series appear to correspond with the silver-bearing formation of Lake Superior, deposits of this metal may reasonably be looked for on the east side of Hudson's Bay. Nuggets of native silver have been found with those of gold in some of the upper branches of the Peace River. Copper-ores which have been discovered in the Rocky Mountains, near the line of the Canadian Pacific Railway, contain a notable quantity of silver.

Gold.—Traces of this metal were found along with the silver by Dr. Harrington in the pyrites of the two localities which have just been referred to. Specks of gold are mentioned by Professor James Tennant as occurring in quartz which had been brought from Repulse Bay, which lies to the north of Hudson's Bay. At the Huronian mine, north of the height-of-land and west of Thunder Bay, Lake Superior, gold is found in promising quantities in a large quartz vein cutting Huronian schists, which has been worked to some extent; and a stamp-mill has been erected at the mine. It is met with, as specks and small nuggets, also in a quartz vein, at Partridge Lake, a short distance northward of the last-named locality. There is reason to believe that to the west of the lower part of the Mackenzie River, a promising region for gold and silver exists. From

private sources it has been ascertained that gold has been washed from the sand and gravel of some of the upper branches of the Youkon and the western tributaries of the Liard; and also of the Rat River, which enters the west side of the delta of the Mackenzie. The fine gold found in the bed of the North Saskatchewan, especially about Edmonton, is washed out of the drift; and it may have had its original source in the auriferous upper parts of the Peace or Liard valleys, having come thence during the glacial period.

Although it is probable that it will be many years before the cheaper and more bulky of the non-metallic minerals of this vast wild region will be sought after, still, as we never know what circumstances may arise to make them them valuable, any facts concerning them are worth recording in advance of the settlement of the region. The knowledge of their existence may sometimes prove a factor in the projecting of railways or in otherwise promoting the development of the country.

Gypsum.—Banks of gypsum from ten to twenty feet high occur on both sides of the Moose River, between thirty-one and thirty-eight miles above Moose Factory, which is situated at the south-western extremity of James' Bay. The upper part is mixed with marl, and only the lower ten feet consist of solid gypsum, which is mostly of a light bluish-gray color. A small proportion is nearly white. A similar deposit of gypsum is reported to occur near the shore of James' Bay, between Moose Factory and Fort Albany. I found a fragment of the mineral last summer among the igneous rocks of the Ottawa Islands in the northeastern part of Hudson's Bay. Sir John Ross reports its occurrence at North East Cape. In Manitoba an impure variety has been found in thin layers in the Cretaceous marls of the Riding Mountains; and nodules and crystals of selenite may be found in these rocks, in almost any part of their distribution in this province and the northwest territories. On the Peace River, at a place called Peace Point, about sixty miles from Fort Chippewyan, at the west end of Athabasca Lake, the cliffs, which are of Devonian age, are largely made up of gypsum. It is also said to occur in considerable quantities a short distance westward of the natural salt deposits of Salt River, a small western tributary of the Slave River, about midway between Lake Athabasca and Great Slave Lake.

Salt.—At the locality which has just been referred to, salt of excellent quality, resulting from the evaporation of brine flowing on the surface, is found in considerable quantities, in crystals about the

size of those of Liverpool salt. It is shovelled directly into the bags in which it is taken to all parts of the district. At a place called La Saline, about half a mile east of the Athabasca River and thirty-five miles below its junction with the Clearwater River, a white incrustation of salt is deposited from brine flowing over a bank composed of a black indurated mixture of sand and asphalt. Excellent salt was formerly manufactured from brine issuing from Devonian rocks at the northwestern and also at the southwestern extremity of Lake Winnipegosis. Springs of weak brine issue from the banks of the White Mud River above Westbourne in Manitoba. The Devonian rocks are extensively spread in the northwest territories and it is to be expected that, when the time comes to require it, salt will be found by boring in many localities.

Soapstone.—The Eskimo both of the northwestern and the eastern sides of Hudson's Bay, as well as those of Hudson's Strait and the coast of Labrador, have been accustomed from time immemorial to make their pots and lamps out of this rock, which they find in various places among the gneisses and crystalline schists of these regions. It occurs in abundance at Red Lake, east of Lake Winnipeg, and again near Falcon Island on Lake of the Woods. I have also met with it on the Mattagami River, about twenty miles below Kenagamisse Lake.

Lignite is well known to occur extensively in the Cretaceous and Tertiary strata of our northwest territories, all the way from the United States boundary line to the mouth of the Mackenzie River. The most easterly localities are on the Souris River in southern Manitoba and on the Swan River near the northwest extremity of Lake Winnipegosis. The quality of these lignites varies greatly. As a general rule, the nearer we approach the Rocky Mountains the better it becomes. Wherever the beds are disturbed or tilted, the quality is improved. In the Rocky Mountains, a bed of semi-anthracite has been discovered near the line of the Canadian Pacific Railway. Beds of lignite are found in the drift on the Mattagami, Albany and Rainy Rivers and on the southwest side of the Lake of the Woods.

Coal, in rocks belonging to the Carboniferous system, is reported by the Arctic explorers to have been found in workable seams in Banks' Land and the islands of the Melville Archipelago.

Anthracite.—When on the east coast of Hudson's Bay, I was presented with a number of small specimens of a very fine variety of

anthracite, said to occur on Long Island, about four miles from its southern extremity. Judging from its appearance and from the very small percentage of ash which it contains it has probably resulted from the alteration of a mineral like albertite (*Report Geol. Survey of Canada*, 1877–78, page 24 C.). It has a bright lustre and a highly conchoidal fracture. Mr. Hoffman found it to contain, fixed carbon 94.91, volatile and combustible matter 1.29, water 3.45, ash 0.35, in 100 parts. Some one has remarked that this anthracite has been "probably washed on shore from some vessel." Among the reasons why this could not have been the case, I may mention that up to the time of its discovery, no vessel had ever carried any anthracite into Hudson's Bay; anthracite, if thrown into the sea would sink; the composition of this mineral is different from that of any other known variety; and lastly, it does not occur on the sea-shore at all, but in the interior of the island.

Petroleum and *asphalt* have long been known to occur in abundance along the Athabasca and Mackenzie Rivers. Their mode of occurrence was investigated in 1882 by the writer and described in the Annual Report of the Geological Survey of Canada, pages 14 to 23 C C. The petroleum appears to come up from the Devonian limestones, and it saturates and blackens a great thickness of sandy Cretaceous strata, which immediately overlie the former, through a great extent of country. On the Athabasca, these black asphaltic sands form banks, extending for miles along the river and sometimes nearly 200 feet high, from which "tar" is constantly oozing. Thickened petroleum or asphalt has been found in various places on Great Slave Lake, along the Mackenzie River and on the upper Peace River. It is said to have been noted also on one of the upper branches of the South Saskatchewan. The bituminous Devonian limestones of the Abittibi River, near the head of James Bay, contain indications of petroleum.

Mica of good quality and in fair-sized sheets is found on the north side of Hudson's Strait, and specimens of it are brought by the Eskimo to every passing visitor. These people also report the existence of sheet-mica on the northwest side of Hudson's Bay, and it was said that some years ago a vessel was loaded with it at Chesterfield Inlet.

Graphite.—Eskimo from the north side of Hudson's Strait brought me specimens both of good amorphous and pure foliated graphite, and reported it to exist there in abundance (See *Report* for 1884, p. 24 D D.). A fine-grained variety of graphite is found

near Fond du Lac on Lake Athabasca. Plumbaginous schists, containing a large proportion of graphite, have been met with among the Huronian rocks near the north shore of Lake Superior.

Asbestus.—This mineral occurs in small quantities near Little Whale River and on the Ottawa Islands in the northeastern part of Hudson's Bay. Fine specimens of it are found in hornblende schists at Rat Portage, where the Winnipeg River leaves the Lake of the Woods, but the quantity seems too limited to be worth working. I have also obtained specimens of it from both sides of Lake Nipigon.

Chromic iron is mentioned by Richardson as among the minerals of the northern Mackenzie River country.

Apatite has been detected near the Coppermine River and on Trout Lake in the southern part of the basin of Moose River (See *Geol. Survey Report* for 1881, p. 6, C.)

Iron Pyrites.—The Eskimo of the west side of Hudson's Bay have brought me numerous specimens of granular pyrites which appear to be derived from large veins. They state that they find it in different places between Chesterfield Inlet and Nevil Bay. A mass of this mineral, apparently of workable extent, occurs on Scottie Island in Lake of the Woods, and good specimens have been sent me from a rapid in the Mattagami River. It has been noticed in small quantities in hundreds of localities throughout the Territories.

Lime.—The Devonian and Silurian limestones of the western, and the dolomites of the Manitounuck or Nipigon formation of the eastern, side of Hudson's Bay afford abundance of good stone for burning into lime. Good material for this purpose is also obtainable everywhere among the Silurian and Devonian rocks which fringe the Laurentian nucleus all the way from Minnesota to Great Bear Lake. Irregular beds or masses of dolomite, often of considerable thickness, are found among the Huronian strata of Lake of the Woods, of Red Lake, to the north of it, and elsewhere.

Hydraulic Cement.—Beds of ferruginous and argillaceous dolomite, which would evidently answer for calcining to form hydraulic cement, occur on some of the islands on the east side of Hudson's Bay near Great and Little Whale Rivers.

Building Stones are abundant among the rocks which have been already mentioned as suitable for burning into lime. The walls of Fort Prince of Wales, at the mouth of the Churchill River, were faced with blocks, four feet long by two feet thick, cut out of the

gray argillaceous quartzite of the neighborhood. The harder quartzites of Marble Island on the west, and of the Manitounuck group on the east, side of the Bay occur in blocks of good shape and size for building. A handsome red granite is met with on Nottingham Island and on the east shore of Hudson's Bay, south of Cape Wolstenholme.

Glass Sand.—The pure white varieties of the quartzites last referred to would answer for glass-making. A beautifully white sand is abundant at the Methy Portage and along the Clearwater River, Athabasca District.

Fire-clays and clays for brick-making, moulding-sand, shell-marl for manure, ochres, peat, flagstones, roofing-slates and other substances found in various parts of the Hudson's Bay Territories might be added to the foregoing list.